

THAT WHICH IS CLAIMED IS:

1. An output driver circuit, comprising:
  - a first totem pole driver stage having at least one PMOS pull-up transistor and at least one NMOS pull-down transistor therein that are responsive to a first pull-up signal and a first pull-down signal, respectively;
  - a second totem pole driver stage having at least one NMOS pull-up transistor and at least one PMOS pull-down transistor therein that are responsive to a second pull-up signal and second pull-down signal, respectively; and
  - a first resistive element having a first terminal that is electrically coupled to drain terminals of the at least one PMOS pull-up transistor and the at least one NMOS pull-down transistor and a second terminal that is electrically coupled to source terminals of the at least one NMOS pull-up transistor and the at least one PMOS pull-down transistor.
2. The driver circuit of Claim 1, wherein the first and second pull-up signals are complementary signals; and wherein the first and second pull-down signals are complementary signals.
3. The driver circuit of Claim 1, wherein the drain terminals of the at least one PMOS pull-up transistor and the at least one NMOS pull-down transistor are electrically connected together at a first output node.
4. The driver circuit of Claim 3, wherein the source terminals of the at least one NMOS pull-up transistor and the at least one PMOS pull-down transistor are electrically connected together at a second output node.
5. The driver circuit of Claim 4, further comprising a second resistive element that is electrically connected between an output terminal of the driver circuit and the second output node.

6. The driver circuit of Claim 5, wherein a resistance of the second resistive element is less than a resistance of the first resistive element.

7. The driver circuit of Claim 1, wherein said second totem pole driver stage comprises:

- a normally-on PMOS pull-up transistor having a drain terminal electrically connected to a drain terminal of the at least one NMOS pull-up transistor; and

- a normally-on NMOS pull-down transistor having a drain terminal electrically connected to a drain terminal of the at least one PMOS pull-down transistor.

8. The driver circuit of Claim 1, wherein said at least one PMOS pull-up transistor comprises:

- a coarsely tuned array of binary weighted PMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted PMOS pull-up transistors.

9. The driver circuit of Claim 8, wherein said at least one NMOS pull-down transistor comprises:

- a coarsely tuned array of binary weighted NMOS pull-down transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-down transistors.

10. The driver circuit of Claim 1, wherein said at least one NMOS pull-up transistor comprises:

- a coarsely tuned array of binary weighted NMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-up transistors.

11. The driver circuit of Claim 10, wherein said at least one PMOS pull-down transistor comprises:

a coarsely tuned array of binary weighted PMOS pull-down transistors in parallel with a finely tuned array of non-binary weighted PMOS pull-down transistors.

12. The driver circuit of Claim 11, wherein said second totem pole driver stage comprises:

a normally-on PMOS pull-up transistor having a drain terminal electrically connected to a drain terminal of the at least one NMOS pull-up transistor; and

a normally-on NMOS pull-down transistor having a drain terminal electrically connected to a drain terminal of the at least one PMOS pull-down transistor.

13. The driver circuit of Claim 1, wherein said first resistive element has a resistance in a range from between about 5 ohms and about 15 ohms.

14. An output driver circuit, comprising:

- a first totem pole driver stage having at least one PMOS pull-up transistor and at least one NMOS pull-down transistor therein that are responsive to a first pull-up signal and a first pull-down signal, respectively;
- a second totem pole driver stage having at least one NMOS pull-up transistor and at least one PMOS pull-down transistor therein that are responsive to a second pull-up signal and second pull-down signal, respectively; and
- a first resistive element having a resistance value in a range from between about 0 ohms and about 20 ohms, said first resistive element having a first terminal that is electrically coupled to drain terminals of the at least one PMOS pull-up transistor and the at least one NMOS pull-down transistor and a second terminal that is electrically coupled to source terminals of the at least one NMOS pull-up transistor and the at least one PMOS pull-down transistor;

wherein said at least one PMOS pull-up transistor comprises:

- a coarsely tuned array of binary weighted PMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted PMOS pull-up transistors; and

wherein said at least one NMOS pull-down transistor comprises:

- a coarsely tuned array of binary weighted NMOS pull-down transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-down transistors.

15. The driver circuit of Claim 14, wherein said at least one NMOS pull-up transistor comprises a coarsely tuned array of binary weighted NMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-up transistors.

16. An output driver circuit, comprising:  
a totem pole driver stage having a PMOS pull-up path and an NMOS pull-down path therein that are electrically connected in series between a power supply line and a reference line, said PMOS pull-up path comprising:  
at least one PMOS pass transistor having a drain terminal that is electrically coupled to an output terminal of the output driver circuit and a gate terminal that is responsive to a first pull-up control signal; and  
an array of PMOS pull-up transistors having drain terminals that are electrically coupled to a source terminal of said at least one PMOS pass transistor and gate terminals that are responsive to course and fine pull-up enable signals, said array of PMOS pull-up transistors comprising a coarsely tuned array of binary weighted PMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted PMOS pull-up transistors.

17. The driver circuit of Claim 16, wherein said NMOS pull-down path comprises:

at least one NMOS pass transistor having a drain terminal that is electrically coupled to the output terminal of the output driver circuit and a gate terminal that is responsive to a first pull-down control signal; and  
an array of NMOS pull-down transistors having drain terminals that are electrically coupled to a source terminal of said at least one NMOS pass transistor and gate terminals that are responsive to course and fine pull-down enable signals, said array of NMOS pull-down transistors comprising a coarsely tuned array of binary weighted NMOS pull-down transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-down transistors.

18. The driver circuit of Claim 16, wherein said at least one PMOS pass transistor comprises first and second PMOS pass transistors that are responsive to first and second pull-up control signals, respectively.

19. The driver circuit of Claim 18, wherein the second PMOS pass transistor is about twice as wide as the first PMOS pass transistor.

20. An output driver circuit, comprising:

- a first totem pole driver stage having at least one PMOS pull-up transistor and at least one NMOS pull-down transistor therein that are responsive to a first pull-up signal and a first pull-down signal, respectively, said at least one PMOS pull-up transistor comprising a coarsely tuned array of binary weighted PMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted PMOS pull-up transistors;

- a second totem pole driver stage having at least one NMOS pull-up transistor and at least one PMOS pull-down transistor therein that are responsive to a second pull-up signal and second pull-down signal, respectively, said at least one NMOS pull-up transistor comprising a coarsely tuned array of binary weighted NMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-up transistors; and

- a first resistive element having a resistance value in a range from between about 0 ohms and about 20 ohms, said first resistive element having a first terminal that is electrically coupled to drain terminals of the at least one PMOS pull-up transistor and the at least one NMOS pull-down transistor and a second terminal that is electrically coupled to source terminals of the at least one NMOS pull-up transistor and the at least one PMOS pull-down transistor.

21. The driver circuit of Claim 20, wherein a pair of PMOS pull-up transistors in the finely tuned array of non-binary weighted PMOS pull-up transistors have widths equal to:  $W+n\beta$  and  $W+(n+1)\beta$ , where  $n$  is a

positive integer,  $\beta$  is a positive number,  $W > 4\mu\text{m}$  and  $n\beta < W$ .

22. The driver circuit of Claim 21, wherein a plurality of PMOS pull-up transistors in the coarsely tuned array of binary weighted PMOS pull-up transistors have widths equal to:  $W$ ,  $2W$  and  $4W$ .

23. An integrated circuit device, comprising:

- a first pull-up path having at least one PMOS pull-up transistor therein that is responsive to a first pull-up signal;
- a second pull-up path having at least one NMOS pull-up transistor therein that is responsive to a second pull-up signal; and
- a first resistive element having a first terminal that is electrically coupled to a drain terminal of the at least one PMOS pull-up transistor and a second terminal that is electrically coupled to a source terminal of the at least one NMOS pull-up transistor;

wherein said at least one PMOS pull-up transistor comprises:

- a coarsely tuned array of binary weighted PMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted PMOS pull-up transistors; and

wherein said at least one NMOS pull-up transistor comprises:

- a coarsely tuned array of binary weighted NMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-up transistors.



24. An integrated circuit device, comprising:

- a first pull-down path having at least one NMOS pull-down transistor therein that is responsive to a first pull-down signal;
- a second pull-down path having at least one PMOS pull-down transistor therein that is responsive to a second pull-down signal; and
- a first resistive element having a first terminal that is electrically coupled to a drain terminal of the at least one NMOS pull-down transistor and a second terminal that is electrically coupled to a source terminal of the at least one PMOS pull-down transistor;

wherein said at least one NMOS pull-down transistor comprises:

- a coarsely tuned array of binary weighted NMOS pull-down transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-down transistors; and

wherein said at least one PMOS pull-down transistor comprises:

- a coarsely tuned array of binary weighted PMOS pull-down transistors in parallel with a finely tuned array of non-binary weighted PMOS pull-down transistors.

25. An integrated circuit device having a PMOS pull-up path therein that is configured to match a load impedance, said PMOS pull-up path comprising:

- at least one PMOS pass transistor having a drain terminal that is electrically coupled to an output terminal of the device and a gate terminal that is responsive to a first pull-up control signal; and

- an array of PMOS pull-up transistors having drain terminals that are electrically coupled to a source terminal of said at least one PMOS pass transistor and gate terminals that are responsive to course and fine pull-up enable signals, said array of PMOS pull-up transistors comprising a coarsely tuned array of binary weighted PMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted PMOS pull-up transistors.



26. An integrated circuit device having a NMOS pull-down path therein that is configured to match a load impedance, said NMOS pull-down path comprising:

at least one NMOS pass transistor having a drain terminal that is electrically coupled to an output terminal of the device and a gate terminal that is responsive to a first pull-down control signal; and

an array of NMOS pull-down transistors having drain terminals that are electrically coupled to a source terminal of said at least one NMOS pass transistor and gate terminals that are responsive to course and fine pull-down enable signals, said array of NMOS pull-down transistors comprising a coarsely tuned array of binary weighted NMOS pull-down transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-down transistors.

27. An output driver circuit, comprising:

a first totem pole driver stage having at least one PMOS pull-up transistor and at least one NMOS pull-down transistor therein that are responsive to a first pull-up signal and a first pull-down signal, respectively; and

a second totem pole driver stage having at least one NMOS pull-up transistor and at least one PMOS pull-down transistor therein that are responsive to a second pull-up signal and second pull-down signal, respectively;

wherein said at least one PMOS pull-up transistor comprises:

a coarsely tuned array of binary weighted PMOS pull-up transistors in parallel with a finely tuned array of non-binary weighted PMOS pull-up transistors; and

wherein said at least one NMOS pull-down transistor comprises:

a coarsely tuned array of binary weighted NMOS pull-down transistors in parallel with a finely tuned array of non-binary weighted NMOS pull-down transistors.